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west virginia department of environmental protection

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Division of Air Quality  
601 57<sup>th</sup> Street, SE  
Charleston, WV 25304-2345  
Phone: 304 926 0475 • Fax: 304 926 0479

Earl Ray Tomblin, Governor  
Randy C. Huffman, Cabinet Secretary  
[www.dep.wv.gov](http://www.dep.wv.gov)

## ENGINEERING EVALUATION/FACT SHEET

### B ACKGROUND INFORMATION

Application No.:	R13-2433C
Plant ID No.:	097-00001
Applicant:	Saint-Gobain Ceramics and Plastics Inc.
Facility Name:	Corhart Refractories/Buckhannon Plant
Location:	Buckhannon
NAICS Code:	327125
Application Type:	Modification
Received Date:	May 31, 2012
Engineer Assigned:	Edward S. Andrews, P.E.
Fee Amount:	\$1000.00
Date Received:	June 4, 2012
Complete Date:	August 15, 2012
Due Date:	November 19, 2012
Applicant Ad Date:	June 4, 2012
Newspaper:	<i>The Record Delta</i>
UTM's:	Easting: 565.4 km      Northing: 4,316.8 km      Zone: 17
Description:	Saint-Gobain proposes to remove the afterburner for Kiln K-36, and only operate the afterburner for K-35 when curing chrome grog refractory.

### DESCRIPTION OF PROCESS

The Saint-Gobain Refractories facility manufactures non-clay refractories for the glass industry, primarily fiberglass and specialty glass. This process requires an assortment of raw materials such as chromic oxide, zircon, tin oxide, alumina, titanium dioxide, binder materials, and many other miscellaneous ingredients. These materials are processed and mixed to formulate different compositions based on the customer requirements. After batching, the materials are shaped to a particular size by various means of compaction. It is then placed in a kiln and fired to temperatures ranging between 1450<sup>0</sup>C (2642<sup>0</sup>F) and 1600<sup>0</sup>C (2912<sup>0</sup>F). The atmosphere in these kilns is critical to the proper sintering of the ceramic materials. Depending on the product, it may require large amounts of excess oxygen or zero oxygen. These variations

can have a significant influence on the stack emissions of the individual kiln. At the completion of the firing cycle the blocks are finished by grinding, sawing, and machining to a specific size and shape as required by the customer. These products are shipped to customers all over the world.

In 2011, Saint-Gobain issued a corporate policy to reduce greenhouse gases across the company by 6% before 2013. Saint-Gobain is reviewing the firing cycle length and any other means of reducing natural gas consumption. One area Saint-Gobain believes could help meet this goal without affecting the quality of the products is removing or reducing the use of two (2) afterburners. There are currently three (3) afterburners. One serves Kilns K-1 and K-2 (installed around 1981), one on Kiln K-35 (installed in 2001), and another for Kiln K-36 (installed in 2005).

At the time of the latter installations, Saint-Gobain was using a polyethylene glycol binder. When this binder was used in large quantities the stack emissions would exceed the 20% opacity limit of Rule 7. In 2004, Saint-Gobain was ordered to reduce these visible emissions. Compliance was achieved by changing the polyethylene glycol binder to a polyvinyl alcohol binder. Prior to the change in binder, Kiln K-36 was already specified with an afterburner. By eliminating the afterburners for K-35 and K-36, Saint-Gobain expects to reduce the facility consumption of natural gas by 12,500 MCF per year at an approximate cost savings of \$63,000. This will also reduce emissions of greenhouse gases, specifically carbon dioxide (CO<sub>2</sub>) by approximately 750 tons per year.

This permit modification application specifically addresses the potential change in air pollution emissions from Kilns K-35 and K-36 without the afterburners. Permit R13-2433B requires the afterburners to be operated during the initial firing cycle when the kiln temperature reaches 150 degrees C and can be shut down once the temperature is above 500 degrees C. The net change in potential emissions that results from not firing the afterburners is less than six is estimated to be less than six (6) pounds per hour and ten (10) tons per year for each kiln.

Saint-Gobain proposes to remove the afterburner from Kiln K-36. The afterburner for Kiln K-35 would remain in place. Should Saint-Gobain need to use this kiln to produce chrome grog which has a potential for excess visible emissions, the afterburner would be used in accordance with the current permit requirements. Chrome grog is currently produced in Kilns K-1 and K-2, which will still employ an afterburner.

## SITE INSPECTION

On October 1, 2009, this writer visited the facility as part of the permit review process for R13-2433B. Mr. Jerry Casto, Equipment, Engineering and Facilities Supervisor, accompanied this writer on the visit. This action does not propose the addition of new equipment or the modification of any existing emission. Thus, the writer determined that a site inspection is not necessary for this particular permitting action.

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## ESTIMATE OF EMISSION BY REVIEWING ENGINEER

Over the years, Saint-Gobain has developed worst case emission factors for carbon monoxide (CO) and volatile organic compound (VOCs) emissions generated from certain products being cured in their kilns. Taking a step back, Saint-Gobain agreed to implement an opacity action plan in 2004 (Constant Order CO-R30-E-2004-07). It was noticed that kilns would exhibit a significant amount of visible during small phase the firing cycle. One of the results of this action plan is that Saint-Gobain developed uncontrolled emission factors for the polyethylene glycol and polyvinyl alcohol binders, which are the following:

Table #1 – Emission Factors from the 2004 Action Plan		
Binder	polyethylene glycol (PEG)	polyvinyl alcohol (PVA)
#VOC/1000 lb batch	20	6
#CO/1000 lb batch	9.046	3.73
#NMHC/1000 lb batch	3.17	1.307

NMHC – non-methane hydrocarbon (methane is not classified as a VOC)

Since then, Saint-Gobain added Kiln K-36 to the facility in 2005 and refined their emission factors after additional testing demonstrations. The factors used in this request are about 10% higher than the ones developed during the Opacity Reduction Plan. The following table is the emission factors used to estimate the uncontrolled CO and VOC emissions in the application.

Table #2 – Emission Factors in the Application		
Refractory	MFG Grog (with liquid PEG)	Zircon (with PVA or solid PEG))
#CO/1000 lb batch	9.945	4.654
#NMHC/1000 lb batch	3.485	6.225

These factors are based on batches and the firing cycle for these batches can vary from a few days to over a few weeks. Second, Saint-Gobain kept working on their binder formulations. Today, Saint-Gobain uses three main types of binders to form the customer desired refractory which are polyethylene glycol in a liquid form (i.e. low-molecular weight), polyethylene glycol in a solid or near solid form (high-molecular weight), and polyvinyl alcohol (PVA). Kiln K-35 can fire refractory with all three types of binders. Kiln K-36 is not as flexible as K-35 and is designed to fire Zircon type of refractory with either PVA or solid PEG binders. Saint-Gobain believes that the organics in the refractory should be completely released during the thermolysis (burn out) phase of the firing cycle, which should not be shorter than 260 hours. This is used to estimate the hourly CO and VOC emission rate from the refractory.

These factors account for the CO & VOC generated from the refractory. To account for the CO and VOC generated from combustion, Saint-Gobain used AP-42 emission factor for natural gas combustion in external combustion sources. These factors were applied with the

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maximum firing rate of the kilns. During a firing cycle, the actual firing rate of the kiln will vary depending on the desired kiln temperature at a particular phase of the firing cycle.

After careful review and follow-up discussions with Saint-Gobain, Kiln K-35 would yield the highest amount of CO when firing MFG Grog refractory. For VOCs, both kilns would yield the highest amount of VOCs when Zircon or refractory with PVA or solid PEG binders. The following is the proposed emission limits for each kiln at their respective permitted production levels.

Table #3 – Proposed CO & VOC Emission Limits						
Kiln	Kiln K-35		Kiln K-36		Current Combined Limit for Both Kilns	Net Change From Both Kilns
Pollutant	lb/hr	TPY	lb/hr	TPY	TPY	TPY
CO	6.76	7.06	5.97	7.35	6.43	7.98
VOC	3.66	2.75	6.20	4.61	0.78	6.58

These proposed rates are a function of the emission factors listed in Table #2 plus the portion from combusting natural gas with a margin of compliance of 1.5. Typically, a margin of compliance of this magnitude would not be considered to be acceptable. However, Saint-Gobain's process is a batch style with varying cycle times to manufacture custom order refractory. Further, Kilns K-35 and K-36 were designed to handle large slab size refractory, which cannot be fired in any of the existing kilns at the facility. In the recent past (2008), Saint-Gobain was asked to do everything reasonably possible to achieve compliance with the permitted NO<sub>x</sub> limit. Saint-Gobain had investigated how thermal NO<sub>x</sub> is formed in their kilns (mainly K-35 & K36), which was finally addressed in Permit R13-2433B. The problems with addressing NO<sub>x</sub> formations are that the combustion solution(s) usually result in the increase of products of incomplete combustion (i.e. CO & VOCs).

Saint-Gobain estimated the greenhouse gas (GHG) potential due to combustion of natural gas in the afterburner. This modification could result in a decrease in GHG potential. Saint-Gobain used CO<sub>2</sub> emission factors published in AP-42 for external combustion sources burning natural gas to estimate the potential decrease. Based on maximum permitted consumption rate of 551,475 therms of natural gas per year, the facility could reduce 3,049 tons of carbon dioxide equivalent (CO<sub>2</sub>e) tons per year.

## REGULATORY APPLICABILITY

The kilns affected by this modification are currently subject to 45CSR7 when the afterburner is not operating and 45CSR6 when the afterburner is operating. Saint-Gobain proposes to remove the afterburner for Kiln K-36 and only operate the afterburner for Kiln K-35 when firing refractory that has been formulated with liquid PEG which is normally MFG Grog refractory.

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Corhart has developed a large zircon binder system for Kilns K-35 and K-36. This system uses PEG in a solid form, which is either in a granular powder or flake form. The big difference between the PEGs used at Saint-Gobain is the degree of polymerization, which increases the molecular weight of the PEG. This difference between these binders with regards to Rule 7 is the temperature that thermolysis occurs at for the refractory. For the liquid PEG binders, it is believed to begin at around 150 C and for solid PEG and PVA binders begin burn out at around 300 C.

This would explain why there was a visible emission problem with the kilns when firing refractory with a liquid PEG binder (i.e. before 2004) and now today there are no visible emissions from the kilns without afterburners firing refractory with solid PEG or PVA. Corhart has phased out the firing of refractory with liquid PEG in kilns that are not equipped with afterburners.

This request does not propose a change in the particulate matter emission limit. Thus, the issued Kilns K-35 and K-36 be able to comply with the 20% visible emission standard of Rule 7 (45CSR§7-3.1) without the afterburner. Currently, the existing kilns (Kilns K-27, K-30, K-26, K-33, and K-34) have not exhibited visible emissions since the phasing out of liquid PEG binder. Therefore, Kilns K-35 and K-36 should meet the visible emission standard of this rule.

The Buckhannon Plant is a major source as defined in 45CSR§14-2.43b. The total combined CO and VOC rates for both of these kilns with this proposed change included are 14.4 and 7.4 tpy respectively. Thus, these changes will not result in an increase greater than 40 tons per year for these two pollutants, which does not meet the major-modification trigger level, the “significant” threshold, as defined in 45CSR§14-2.74.

The result of this process change will allow Saint-Gobain to decrease the GHG potential of the facility by nearly 3,000 tons of CO<sub>2</sub>e per year. The proposed modification does not increase any NSR pollutant above the significance level. Therefore, no further review of this application is required under 45CSR14.

Upshur County, where the Buckhannon Plant is located, is currently classified as in attainment for all pollutants. Therefore, this application is not subject to the provisions of 45CSR19. Further, this modification does not affect the facility status as a minor source of HAPs and is not subject to any subpart of 40 CFR 63.

Saint-Gobain filed a permit modification application in accordance with 45CSR13 to include the proper public notice and filing fees with the application. With this submittal, Saint-Gobain filed a significant modification application to incorporate this modification in the facility’s Title V Permit. This significant modification is pending upon the outcome of this permit action. The only applicable change that will occur as result of this permitting action is that Kiln K-36 is no longer subject Rule 6 and Kiln K-35 is only subject to Rule 6 when the afterburner is required for firing refractory with liquid PEG binder. It’s recommended to the Director that to resolve potential inconsistency between Rules 6 & 7 that the requirements of Rule 7 should prevail at all times for Kiln K-35 regardless of the refractory or when the

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afterburner is in operation. 45CSR§6-11 and 45SR§7-12. authorizes the Director to resolve such insistences. The only difference between the visible emission standard between the two rules it that Rule 7 allows opacity up to and including 20% and Rule 6 only allows up to 20% but not including.

#### TOXICITY OF NON-CRITERIA REGULATED POLLUTANTS

This particular modification does not constitute any physical changes of the kilns other than the removal of the afterburner for Kiln K-36. In addition, Saint-Gobain proposed only to increase the hourly and annual permitted limits for CO and VOCs from these kilns. No increases of any other pollutants were proposed or considered under this application. Thus, the facility status as a minor source of hazardous air pollutants will not be affected by this permitting action. As a result, no information concerning the toxicity of non-criteria regulated pollutants was presented in this section.

#### AIR QUALITY IMPACT ANALYSIS

The writer deemed that an air dispersion modeling study or analysis was not necessary, because the proposed modification does not meet the definition of a major modification of a major source as defined in 45CSR14.

#### MONITORING OF OPERATIONS

The existing monitoring should be adequate for determining compliance. The permittee is already required to conduct visible emission checks, monitor fuel usage, and production rates. The only new monitoring needs to identify the type of refractory fired in Kiln K-35 (liquid PEG or not).

#### CHANGES TO PERMIT R13-2433B

Saint-Gobain suggested changing the NO<sub>x</sub> limits in both kiln in Permit R13-2344B. One, this would not be appropriate for Kiln K-35. Saint-Gobain wants to retain the ability use of afterburner in Kiln K-35 from firing refractory with liquid PEG binder. Second, Saint-Gobain was only required to operate the afterburners for a limited timeframe of the firing cycle. According to Saint-Gobain, the afterburners accounted for about 25% of the total NO<sub>x</sub> potential from these two kilns, which is about 5.5 tpy. This was estimated based on using natural gas combustion factors from AP-42, which assumes steady stated flow combustion. Saint-Gobain's kiln firing cycle is constantly changing through the whole cycle. So, the actual CO and NO<sub>x</sub> emission is constantly changing during the cycle. Thus, it is not recommended to change the proposed NO<sub>x</sub> limits for these kilns.

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The CO and VOC emissions limits are being changed as proposed. Other changes are omitting the afterburner requirements for Kiln K-36, which are items e through f of Condition 4.1.2. Item d. of Condition 4.1.2. was revised to prohibit the firing of refractory with liquid PEG binder in Kiln K-36. For Condition 4.1.1., a new item was add that requires the afterburner to be operating only when firing refractory with liquid PEG binder in Kiln K-35. Then, the existing conditions for the afterburner apply.

#### RECOMMENDATION TO DIRECTOR

The information provided in the permit application indicates the proposed modification of the facility will meet all the requirements of the application rules and regulations when operated in accordance to the permit application. Therefore, this writer recommends granting Saint-Gobain Ceramics and Plastics Inc. a Rule 13 modification permit for their Corhart Refractories facility located near Buckhannon, WV.

Edward S. Andrews, P.E.  
Engineer

September 7, 2012  
Date

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